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Tel 916.920.0300
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CH2MHILL

January 24, 2003

Ms. Kristy Chew
Siting Project Manager
California Energy Commission
1516 Ninth Street, MS-15
Sacramento, CA 95814

RE: Data Responses, Revised Informal Set 13
Cosumnes Power Plant (01-AFC-19)

On behalf of the Sacramento Municipal Utility District, please find attached 12 copies and one original of the Revised Informal Data Responses, Set 13, which addresses the proposed Drainage Plan. This set includes drawings, calculations and technical specifications.

Please call me if you have any questions.

Sincerely,

CH2M HILL

Amar [illegible] for

John L. Carrier, J.D.
Program Manager

c: Colin Taylor/SMUD
Kevin Hudson/SMUD
Steve Cohn/SMUD

COSUMNES POWER PLANT
(01-AFC-19)

REVISED INFORMAL DATA RESPONSE, SET 13

Submitted by

SACRAMENTO MUNICIPAL UTILITY DISTRICT (SMUD)

January 24, 2003

CH2MHILL

2485 Natomas Park Drive, Suite 600
Sacramento, California 95833-2937

Technical Area: Water and Soil Resources
Author: Richard Latteri
CPP Author: EJ Koford

BACKGROUND

The following questions were asked at the Data Response and Issues Resolution Workshop held on June 12, and conference call on June 14, 2002.

DATA REQUEST

W&SR-2: Please revise Figure W&SR 250a to show, on a topographic base, the plant site plan, laydown area and rerouted drainages.

Response: SMUD received comments from the CEC, the public and the agencies regarding the previous response to this request, and has modified the laydown area grading and drainage plan to incorporate recommendations. Additional modifications were made to a revised drainage plan prepared January 22, 2003. The following narrative describes the current laydown area grading and drainage plan, as illustrated in the attached drawings, No. 103S002 (Sheets 1 through 6). Also included are one set of calculations for storm water runoff volume and structures (CL/010325.0001-21, 1/23/2003), and a riprap and rock lining technical specification.

Objectives for Laydown Area

The objectives of revising the laydown area were to minimize impacts to wetlands and the biota that occupy them, as well as control potential off-site migration of contaminants. Part of the objective of preserving wetlands is to avoid modifying them to the extent feasible. As a result, SMUD has proposed that most of the east swale be avoided, and that the laydown area straddle the swale, separated by a suitable (25-foot or more) buffer from the wetland course. The advantage of this approach is in preserving the east swale, rather than attempting to restore it at a later date.

Layout for Laydown Area

The footprint (outer boundary) of the laydown area does not change from the current polygon design depicted in AFC Supplement D. The small, naturally occurring west swale at the laydown area will drain west-northwest as shown by the arrows. In response to CEC and public comments, CPP now proposes to route the west drainage under Clay East Road at the present location, and over a gravel swale into the stormwater collection system for the CPP. This has the primary advantage of providing for capture and treatment of any oily water that could enter the drainage, prior to discharge to Clay Creek. As the drainage meanders toward Clay

East Road, it is directed away from the laydown area due to the higher finished elevation of the laydown area. Best management practices (BMPs) such as fiber rolls and excelsior matting would protect the built-up contours from erosion. The existing culvert will direct water underneath Clay East Road to accommodate drainage from the west swale (approximately 10 cubic feet per second (cfs) for the 100-year event. This culvert installation will route the flow to the west through the switchyard area of the plant site, and from there into the detention basin on the north side of CPP.

The laydown area will be contoured to drain to the naturally occurring and existing east swale that is established near the middle of the laydown area. Approximately ¾ of the laydown area stormwater will drain toward this eastern swale. There is no retention basin in the laydown area. BMPs such as wattles, silt fences and straw bales (determined in consultation with RWQCB) will be used to capture sediment or oils in stormwater. Sediment is expected to be low due to a gravel surface that will be applied to the laydown area. The eastern swale will still receive upland flow calculated by the rational method (62 cfs for 100-year storm event). Silt fencing will be installed at least 25 feet from both sides of the entire length of the natural swale as it traverses through the laydown area. The laydown area surrounding the last 250 feet of this swale will be contoured to guide drainage to a culvert system. An appropriately-sized culvert system will be installed underneath Clay East Road to drain the east swale runoff to the east side of the CPP site. BMPs such as matting and fiber rolls will be installed to minimize scour at the culvert exit, until natural vegetation can stabilize the channel.

As calculated, the east culvert will be able to contain a conservatively calculated 100-year storm flow without overtopping the roadway. The existing east and west swale drainage is currently provided by a single 17-inch x 25-inch arch culvert without special protection at the roadway apron. There is no evidence of historical scouring at the roadway apron under existing conditions with the smaller culverts.

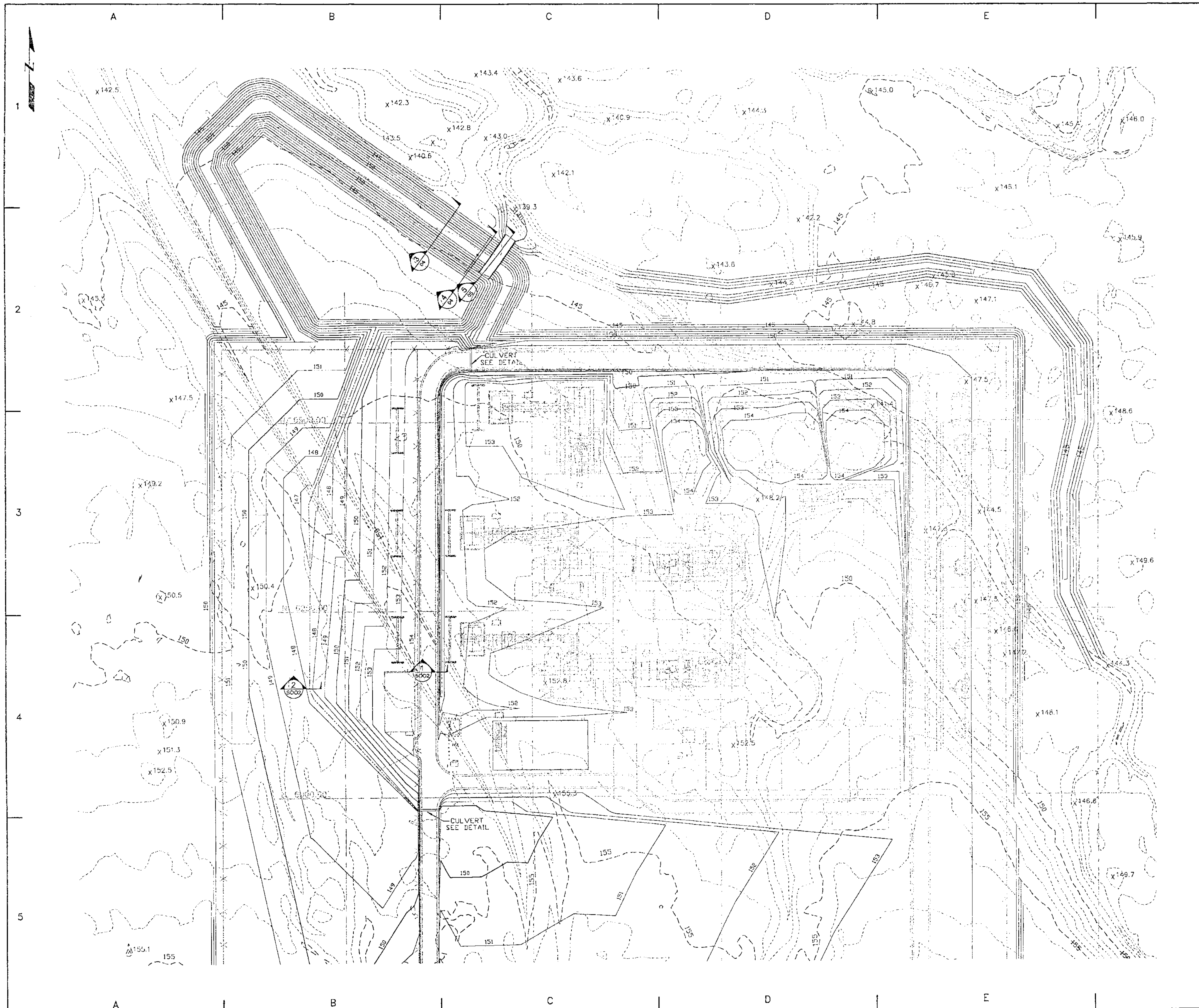
Post-construction Restoration

After construction, the gravel covering the surface of the laydown area will be collected, silt fences removed, and the laydown area revegetated. No major recontouring of the laydown area is required, since the drainage is sloped toward the eastern swale with a smaller portion to the western swale.

Plant Site Details

The plant site detention basin footprint is unchanged. The bottom of the detention basin is at elevation 142 feet, with the top elevation at 152 feet. The spillway crest is at 148 feet, providing a 4-foot freeboard, although a 3-foot freeboard is conservatively used in the calculations. The concrete spillway uses a baffle design for velocity reduction. BMPs or other erosion control methods will be used to the extent needed to comply with an NPDES general stormwater permit. BMPs such as a short length of riprap or other suitable erosion control method necessary to meet NPDES general stormwater permit requirements will be provided at the outfall of the 12-inch PVC pipe.

To ensure drainage does not scour the northeast corner of the plant site, the current swale at the northeast corner will be rerouted north, then west in a slightly meandering pattern as shown on the drawings to rejoin the natural drainage pattern. As recommended in Informal Data Response, Set 6, erosion fabric and other BMPs will be used to protect the plant fill area against erosion immediately after construction, and vegetative erosion protection for long-term erosion control.



NOTES:

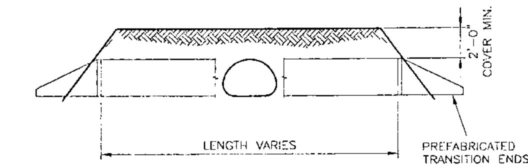
1. TOP OF CONCRETE = 154'-0"

REFERENCE DRAWINGS:

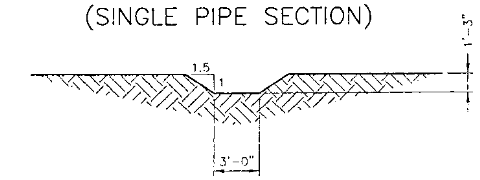
1. GENERAL ARRANGEMENT D010325-100L100-01

LEGEND:

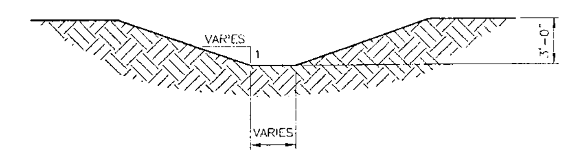
- EXISTING COUTOURS
- FINISHED GRADE CONTOURS
- FLOW LINE



CULVERT DETAIL
42"x29" ARCH PIPE, RCP
SLOPE = 0.027
(SINGLE PIPE SECTION)



SECTION 1
PERIMETER ROAD DRAIN DITCH
SLOPE = 0.005



SECTION 2
SUBSTATION DRAINAGE SWALE
SLOPE = 0.0035
N.T.S.

FIGURE W&SR 2R
(Sheet 1)

0 ISSUE FOR CONSTRUCTION

UTILITY ENGINEERING

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

COSUMNES POWER PLANT
SITE PLAN
FINISH GRADING
PHASE 1

D010325-103S002

LICENSED PROFESSIONAL ENGINEER
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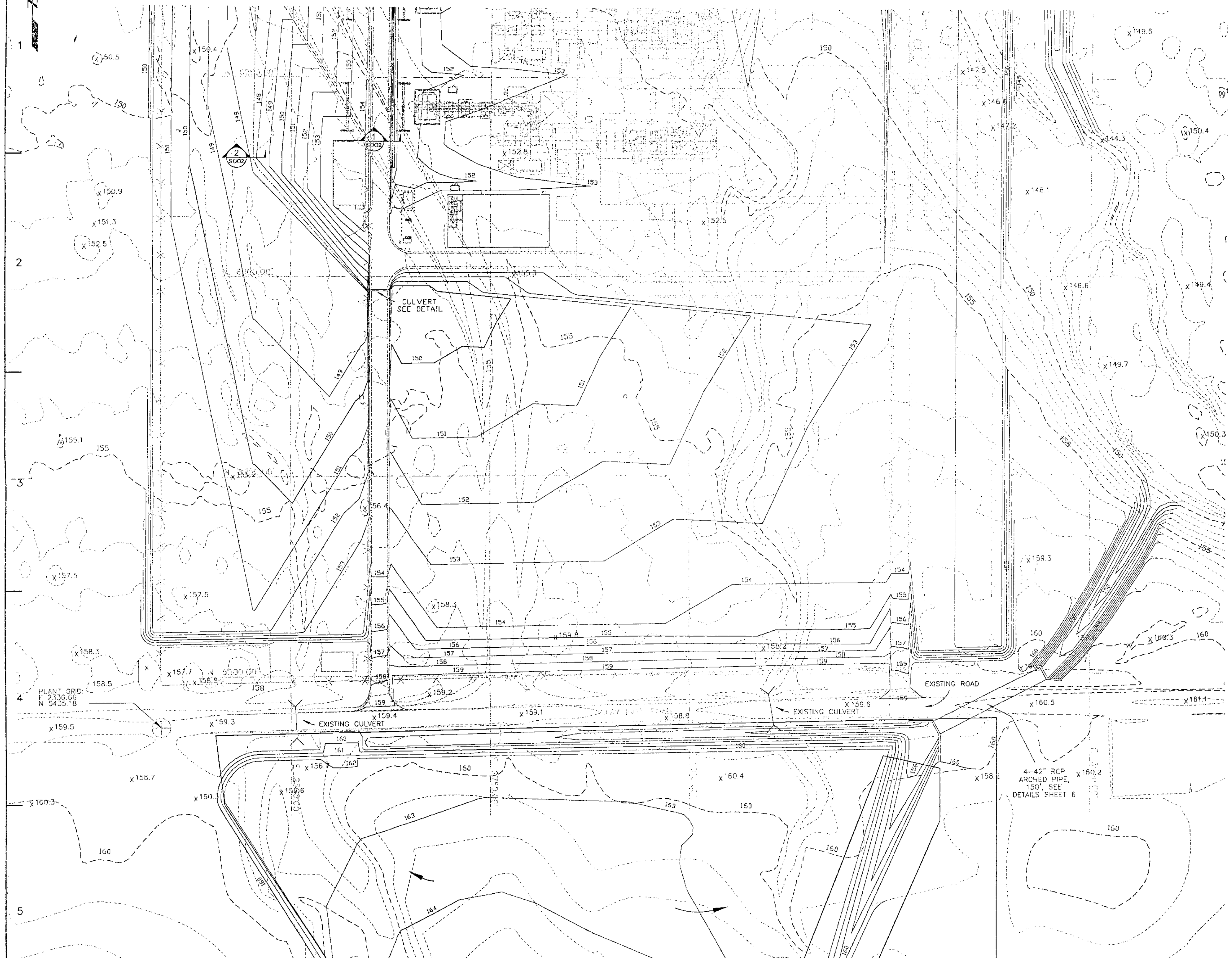
NO. C-63050
EXP. 06-30-2006
CIVIL
STATE OF CALIFORNIA



NOTES:

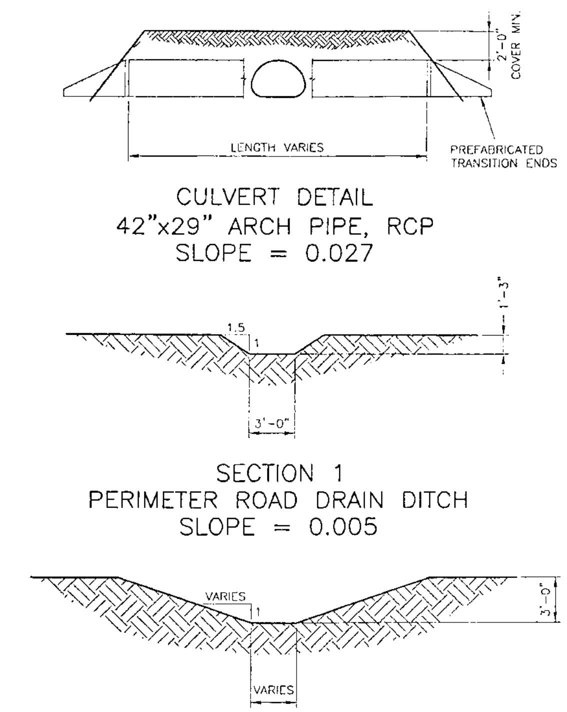
1. TOP OF CONCRETE = 154'-0"

REFERENCE DRAWINGS:

1. GENERAL ARRANGEMENT D010325-100L100-01

LEGEND:

- EXISTING COUTOURS
- FINISHED GRADE CONTOURS
- FLOW LINE
- SHEET FLOW



CULVERT DETAIL
42"x29" ARCH PIPE, RCP
SLOPE = 0.027

SECTION 1
PERIMETER ROAD DRAIN DITCH
SLOPE = 0.005

SECTION 2
SUBSTATION DRAINAGE SWALE
SLOPE = 0.0035
N.T.S.

FIGURE W&SR 2R
(Sheet 2)

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COSUMNES POWER PLANT
SITE PLAN
FINISH GRADING
PHASE 1

D010325-103S002 | 02 | 0

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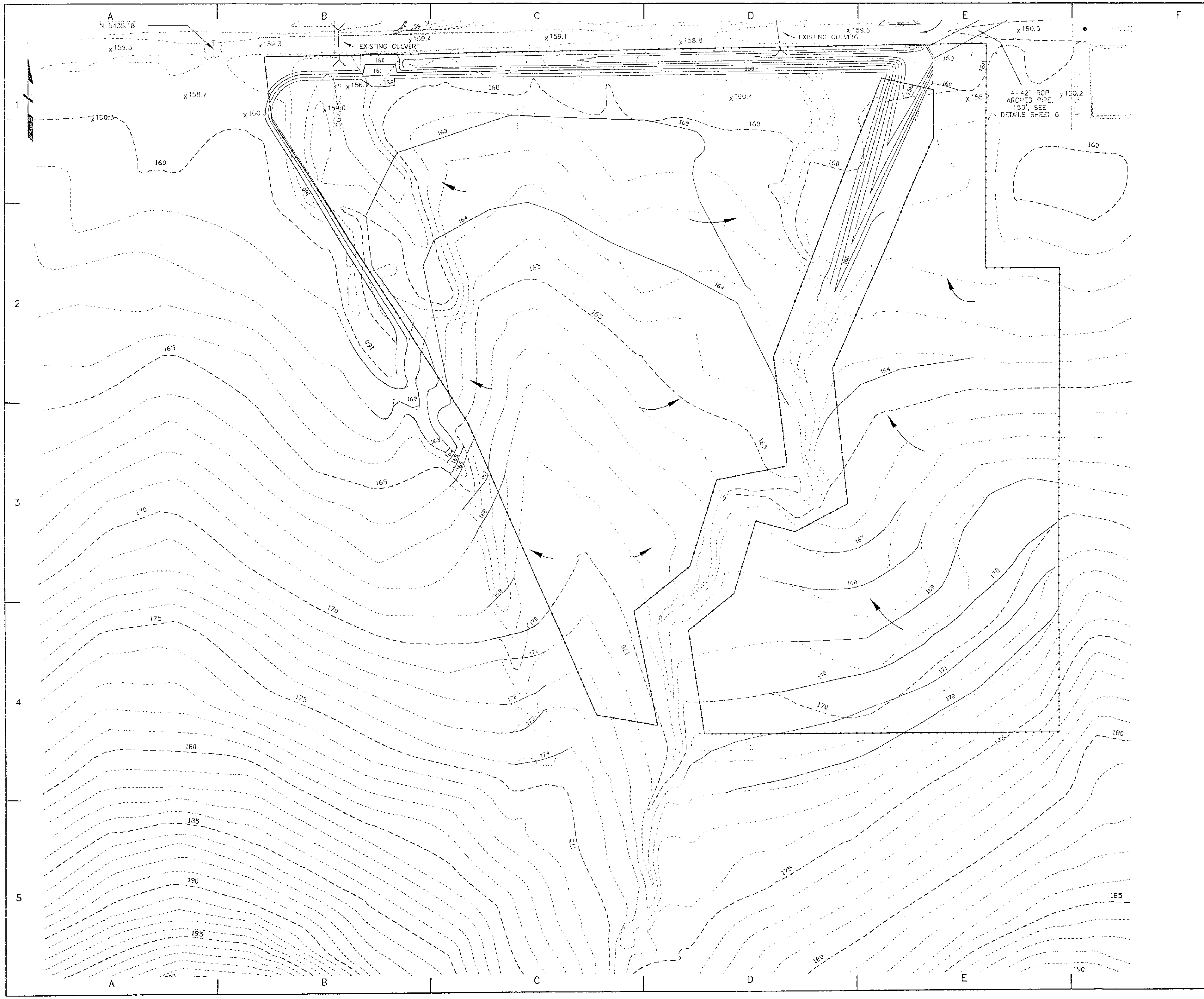

NOTES:

1. TOP OF CONCRETE = 154'-0"

REFERENCE DRAWINGS:

1. GENERAL ARRANGEMENT D010325-100L100-01

LEGEND:

- EXISTING COUTOURS
- FINISHED GRADE CONTOURS
- LAYDOWN AREA BOUNDARY & FENCE
- SHEET FLOW

FIGURE W&SR 2R (Sheet 3)

NO	REVISIONS	DATE	BY	CHK	DSNR	APPR
0	ISSUE FOR CONSTRUCTION	01-13-03	WJ			

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COSUMNES POWER PLANT
SITE PLAN – LAYDOWN SITE
FINISH GRADING
PHASE 1

DRAWN WCJ 12-18-02 — 01-13-03 — 1-13-03

CADD DRAWING NUMBER: D010325-103S002 | SHEET 03 | REV 0

GENERAL NOTES

1. ALL CONCRETE SHALL BE 4000 PSI @ 28 DAYS.
2. ALL REBAR SHALL BE GRADE 60.
3. ALL REBAR SHALL HAVE 3" CLEAR COVER.
4. SEALANT – SONNEBORN SONOLASTIC NP-1 OR EQUAL, COLOR ALUM GREY.
5. GROUT – FIVE STAR GROUT OR EQUAL (CEMENT + BASED, NON-METALLIC, NON-SHRINK).

LEGEND

- 12" MAXIMUM RIP RAP
- 12" DEEP 1 1/4 ø ROCK
- NATIVE SOIL BACKFILL

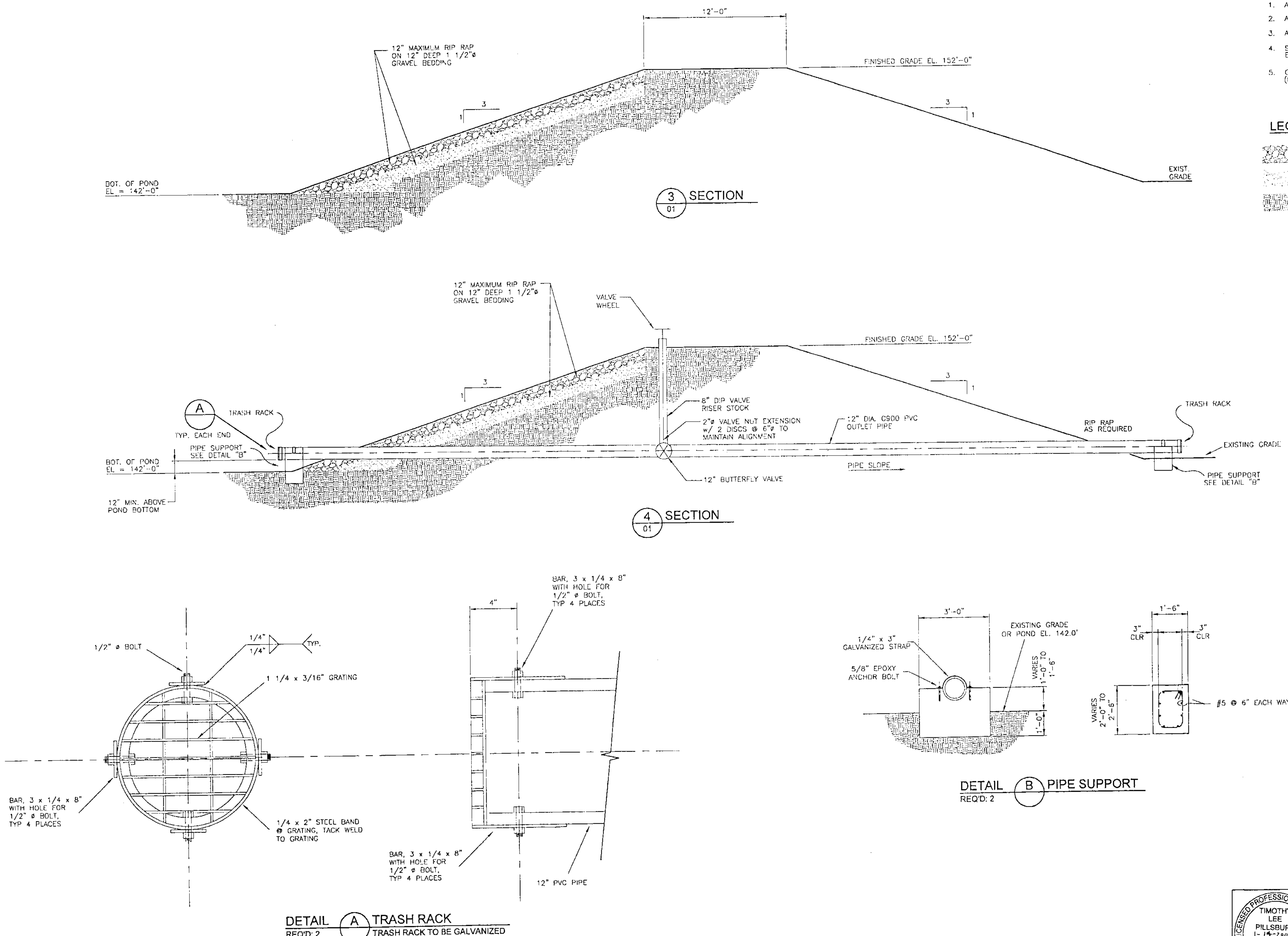

FIGURE W&SR 2R
(Sheet 4)

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UTILITY ENGINEERING

SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

COSUMNES POWER PLANT
SITE PLAN
SECTIONS & DETAILS

D010325-103S002 04 0

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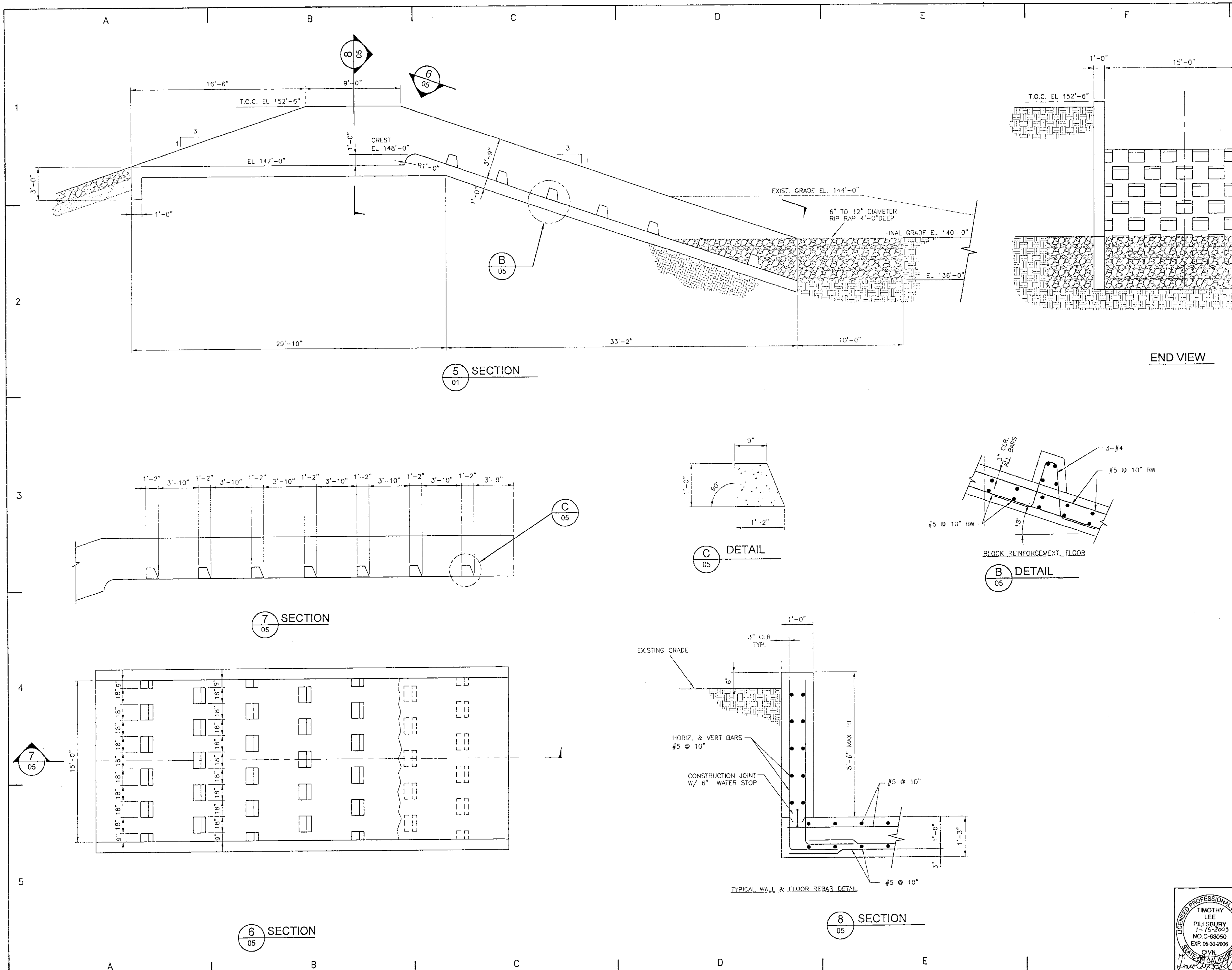

FIGURE W&SR 2R
(Sheet 5)

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SMUD
SACRAMENTO MUNICIPAL UTILITY DISTRICT

COSUMNES POWER PLANT
SITE PLAN
DETENTION POND SPILLWAY
PLAN, SECTIONS & DETAILS

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STATE OF CALIFORNIA

D010325-103S002 | 05 | 0

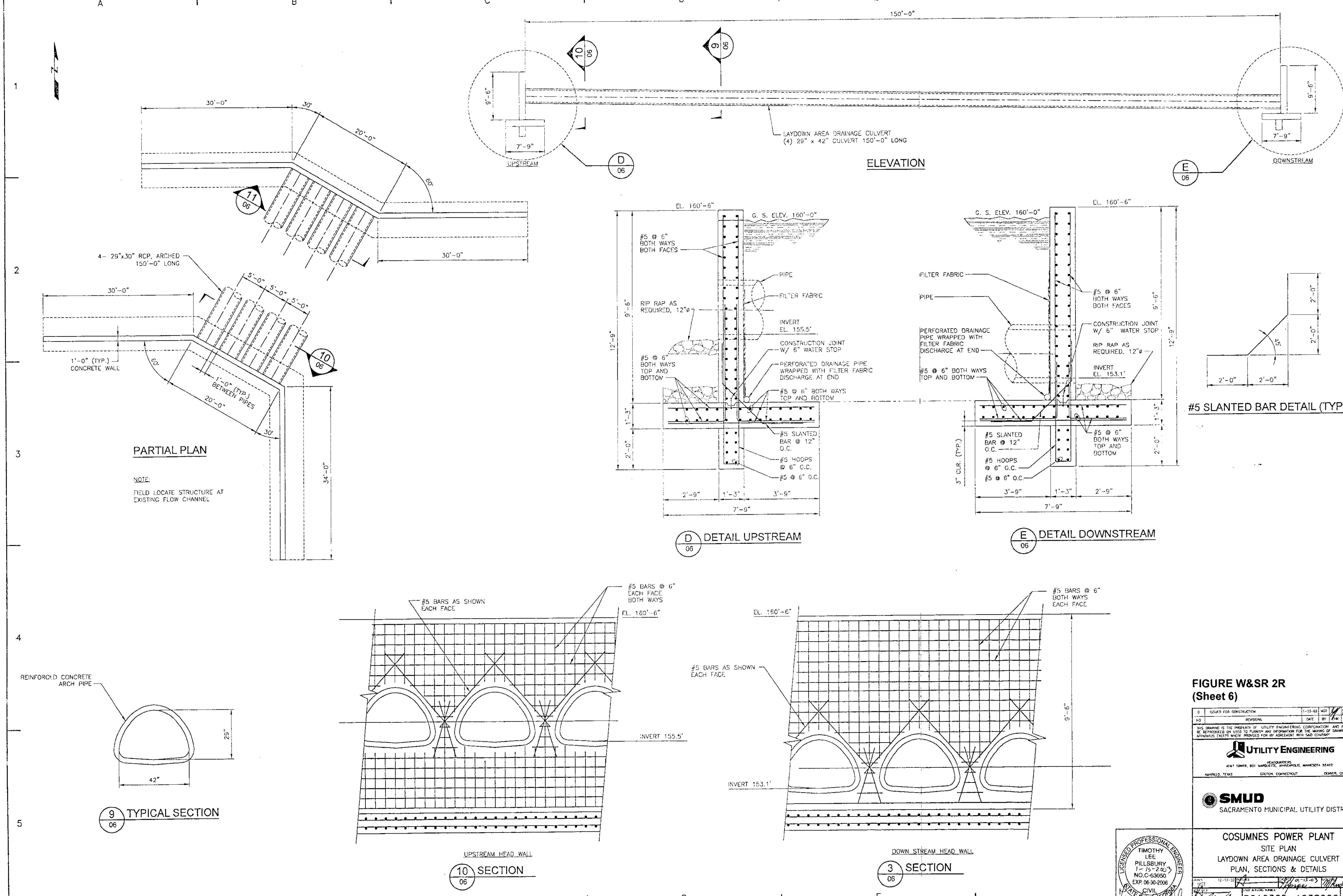

FIGURE W&SR 2R
(Sheet 6)

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COSUMNES POWER PLANT
SITE PLAN
LAYDOWN AREA DRAINAGE CULVERT
PLAN, SECTIONS & DETAILS

D010325-103S002 06 0

SECTION 02371

RIPRAP AND ROCK LINING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes

1. Riprap for channels, embankments, and culvert headwalls.

B. Related Sections

1. Section 01320 – Submittals for Construction.
2. Section 02311 – Rough Grading.
3. Section 02315 – Excavation and Fill.
4. Section 02320 – Backfill.
5. Section 02324 – Trenching.
6. Section 02610 – Pipe Culverts.

1.2 SCOPE OF WORK

Not Used.

1.3 REFERENCES

A. California Department of Transportation (DOT) Standard Specifications for Road and Bridge Construction, Latest Edition.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with California DOT Standard Specifications for Road and Bridge Construction.

PART 2 PRODUCTS

2.1 MATERIALS

A. Riprap shall be well graded with 70% by weight not less than 3 inches in least dimension. No more than 5% by weight shall pass the #4 sieve. Broken concrete is not acceptable for use as rip-rap.

B. Geotextile fabric: Non-biodegradable, woven, submitted to Engineer for approval.

PART 3 EXECUTION

3.1 PLACEMENT

A. Place geotextile fabric over substrate, lap edges, and ends.

B. Place riprap at culvert pipe ends, at embankment slopes, and as indicated on design drawings as provided by Engineer.

C. Installed thickness: 8 inch average.

3.2 SCHEDULES

A. Apply riprap as shown on design drawings as provided by Engineer.

END OF SECTION

UTILITY ENGINEERING

Technical Services Building
*550 15th Street, Suite 800 * Denver, CO 80202*
*(303) 571-6400 * FAX(303) 571-7868*

COST CODE CALCULATIONS

CALCULATIONS
FOR
STORM WATER RUNOFF VOLUME AND STRUCTURES

Calculation Number: CL/010325.0001-21
Revision: 02 (1/23/2003)

SACRAMENTO MUNI UTILITY DIST
SMUD - COSUMNES POWER PROJECT

Designer: ______________

Reviewed: Mark A Anderson

UTILITY ENGINEERING

12-2-02

SMUD Summary of Detention Pond Design

1. Main Detention Pond - U1, U2, Sub areas

a. Capacity w/ 3' freeboard ≅ 6.40 AF
Volume of 100 yr Event Runoff, developed Site per SCS Rational Method =
6.256 AF

b. Peak inflow, 100 yr = 45.94 cfs

c. Crest @ 148' elev Top Berm 152' elev
Overflow @ 46 cfs, 1' deep → 15' wide
Water Surface Elev @ 100 yr event 149.0

d. Low flow outlet = 12" PVC Pipe w/ gate Valve
Q_n = 24.17 cfs
Limit to 22 cfs = 10 yr event on undeveloped site

e. Freeboard = 3'-0"
w/ Bottom @ 142.0 elev

* Summary:
Detention Pond Designed to Contain 100 yr event Runoff
Pond Spillway designed to Pass Same w/ 3' freeboard
Outlet pipe 12" PVC w/ Valve capacity based on passing 10 yr event Runoff @ 22 cfs ± from undeveloped Site

H. Noble UTILITY ENGINEERING 11-7-02

SMUD - Consumnes Power Project

Storm drainage & runoff control, Ponds

Using 100 year, 24 hour event, 10 year 24 hr event

Using Soil Conservation Service Methods

Q = ciA & Spreadsheet

"

SCS Type I Rainfall distribution, CN = 90

See Spreadsheets for details

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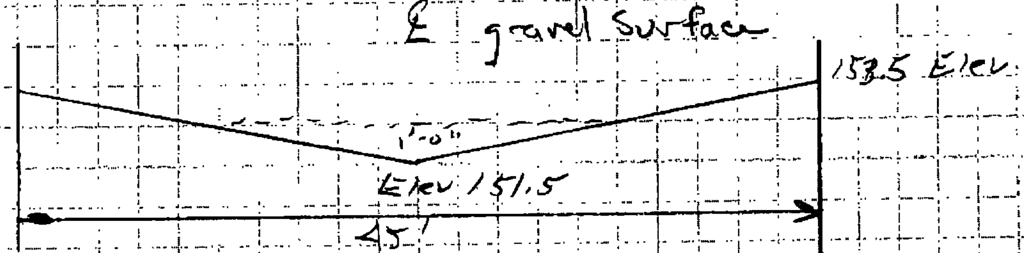
Swale Design - Substation & Phase 2 area



Design Q = 15.04 +

$A = 2 \times (\frac{1}{2} b \times h) = 2(\frac{1}{2}\ 22.5 \times 2) = 45\ sf, ds$

$11.25 \times 1 = 11.25\ sf\ d$

$R = \frac{A}{wp} = \frac{11.25}{22.5} = .5$

n = .035   0.0035 Slope

$Q = \frac{1.49}{n} \times A R^{2/3} \times S^{1/2}$

d	A	$R = \frac{A}{P}$	$R^{2/3}$	$S^{1/2}$	Q -
1	11.25	.5	.630	.0592	17.849

Q = AV

17.84 = 11.25 V

V = 1.586 ✓ fps

17.85 > 15.04 + ✓ cfs

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Collection Ditch Dsn.

Ditch w/ Slope .005 SS = $1\frac{1}{2}:1$
Bw = 3

d = 1.2 Dsn Q = 4.8 cfs

$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$

$Q = \frac{1.49}{.035} \times 5.76 \times .79^{2/3} \times .005^{1/2}$

Q = 14.81 > 4.8

w/ d = .4 A = 1.44 r = .32

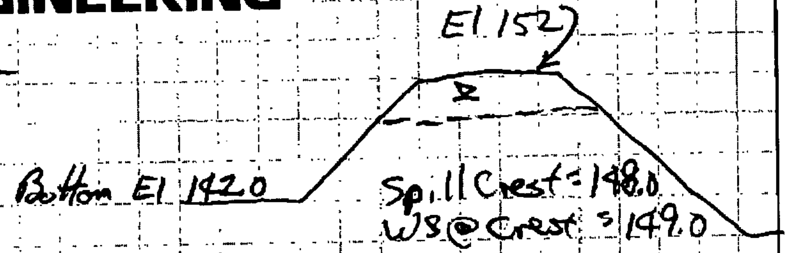
Q =	d	A	R	$R^{2/3}$	S	$S^{1/2}$
2.02	.4	1.44	.32	.4679	.005	
6.95	.8	3.36	.57			
4.13 ✓	.6	2.34 ✓	.45 ✓			

d ≅ .65 @ S = .005 ≅ 8" deep

V ≅ 1.765 fps

HW SMUD UTILITY ENGINEERING 1-20-03

Plant Site Storm Water
Detention Pond
Volume



Pond Volume w/ 3' freeboard

Scale ≅ 1" = 60'

Pond Bottom Area Elev 142.0

$\frac{55+50}{2} \times 360 = 18,900$

$\frac{1}{2}\ 205 \times 105 = 10,672$

$\frac{1}{2}\ 160 \times 105 = 8,400$

Bottom Area = 37,972

Area @ WS Elev 149.0*

$405 \times 70+75/2 \quad 29,363$

$\frac{1}{2} \times 125 \times 225 = 14,063$

$\frac{1}{2}\ 125 \times 180 = 11,250$

54,676

* Elev 149.0 = Spillway dsn flow Water Surface @ 100 yr event passing

$d = 149.0 - 142.0 = 7.0$

$\text{Volume} = \left(\frac{37,972 + 54,676}{2}\right) \times 7.0 = 324,268$ cuft

$= 7.44$ Ac. ft > 6.26

Note @ WS Elev 148.0, Top of Spillway Crest Volume =

≅ 6.38 Ac ft

A. Noble

UTILITY ENGINEERING

11-20-02

SMUD

Detention Pond Low flow outlet

Based on 10 year, 24 hour event on undevelloped site

Max $Q = 21.46$ cfs

12" PVC w/ 12" Valve 70' pipe length

$$H = \left(1 + k_c + k_v + \frac{29 n^2 l}{R^{1.33}}\right)\frac{V^2}{2g}$$

$K_v = .2$

$K_c = .9$

$R = D/4 = 1/4 = .25$

$n = .013$ for PVC pipe

$H = 4'-0"$

$$4 = \left(1 + 0.9 + 0.2 + \frac{29 \times (.013^2) \times 70'}{.25^{1.33}}\right)\frac{V^2}{2g}$$

$$4 = (2.1 + 2.1774)\frac{V^2}{2g}$$

$$4 = 4.2774\frac{V^2}{2g}$$

$257.6 / 4.2774 = V^2$ $\sqrt{60.22} = 7.76$

$A_{12} = \pi r^2 = 3.14$

$Q = AV = 3.14 \times 7.76$

$Q = 24.38$ cfs > 21.46 cfs Calibrate gate to stop @ 22.10

HN

UTILITY ENGINEERING

11-15-02

SMUD

Detention Pond Overflow Spillway

Design for 100 year 24 hour Storm

Max Flow = 45.94 cfs

discharge - overflow Spillway = $Q = C_w L h^{3/2}$

$Q = 46$ cfs

L = Length of Overflow Section

h = head = 1'-0"

C_w = flow Coefficient = 3 to 4 worst case, curved overflow Spillway crest

$Q = 46 = 3 \times L \times 1.0^{3/2}$

$46 = 3L$

$L = 15.33 \rightarrow$

$V = Q/A = 46/16 = 2.87$ fps

UTILITY ENGINEERING 12-5-02

SMUD. Stormwater Detention Pond

Spillway - Baffled Chute design

USBR Engrng Monograph #25
"Dsn of Stilling Basins", 1978

peak flow 45.94 cfs

15' wide spillway

spillway unit discharge = 46/15 = 3.06 cfs

use unit discharge of 10 cfs for Structure Ds

$Q_T = 10 \times 15 = 150$

V_c = Critical Velocity = $\sqrt[3]{gq} = \sqrt[3]{32.2 \times 10} = 6.85$

$= \sqrt[3]{32.2 \times 3.06} = 4.61$ fps

Actual Velocity $= \dfrac{Q}{15 \times .83} = 3.69$ fps < 4.61

$Q = AV$

∴ flow Subcritical

Baffle Pier Height = .8Dc

$D_c = \sqrt[3]{\dfrac{q^2}{g}} = \left(\dfrac{10^2}{32.2}\right)^{1/3} = 1.459'$

Baffle ht = $1.459 \times .8 = 1.16$

Use 1'-0" Baffles

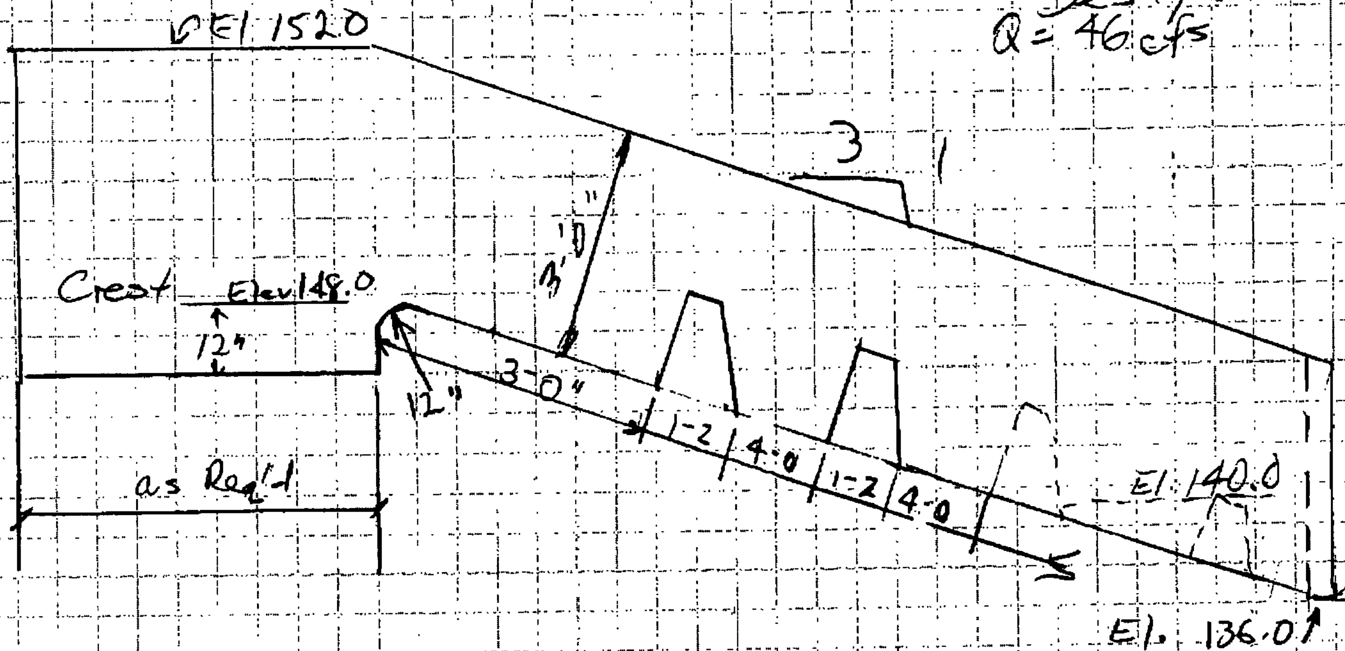
HW

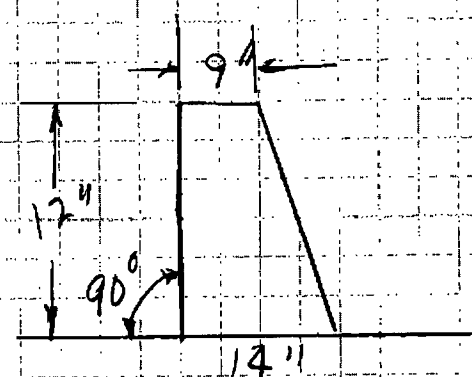
UTILITY ENGINEERING

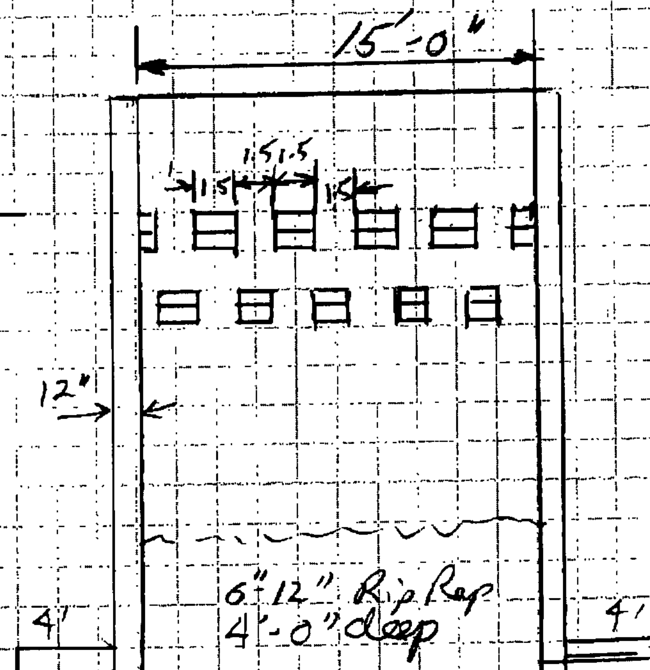
12-10-02

SMUD

Detention Pond Spillway Design
Q = 46 cfs







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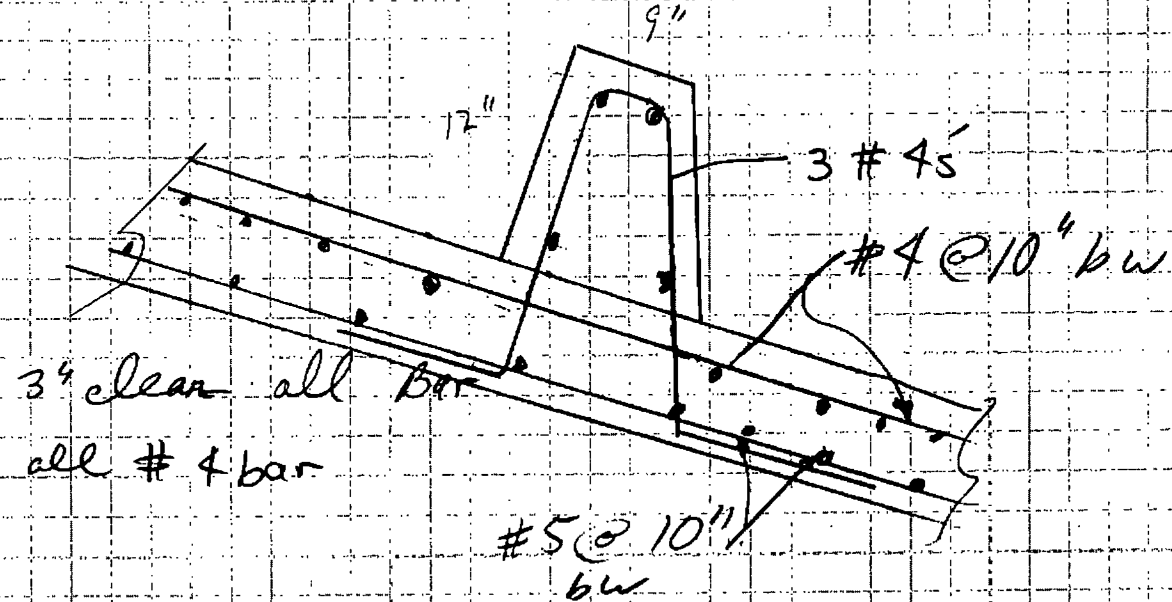
Block Reinforcement, Floor



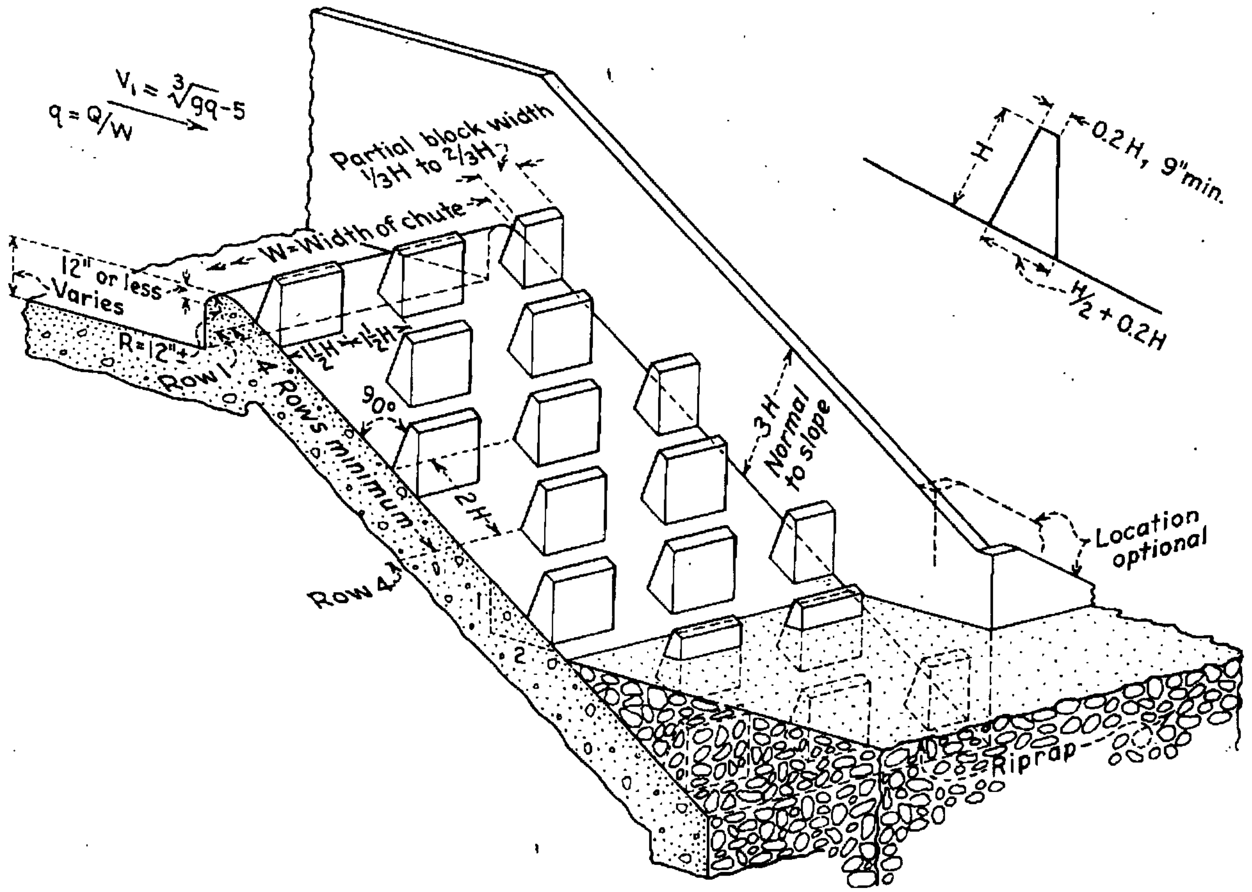
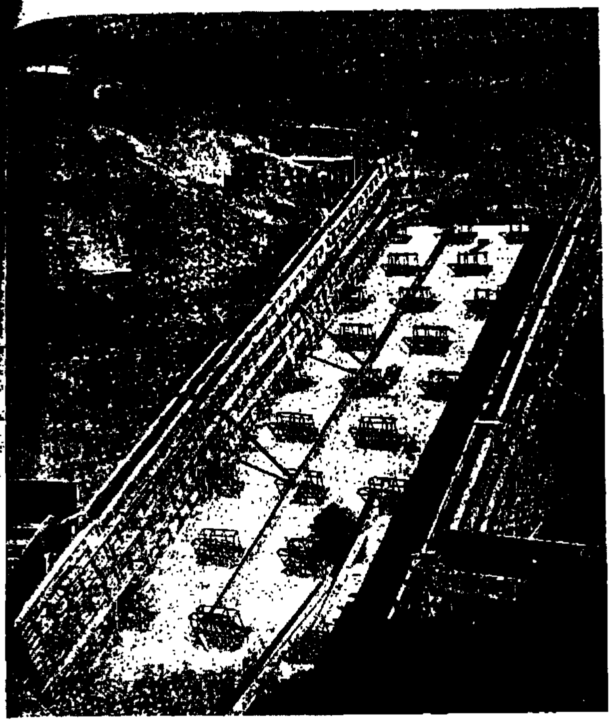
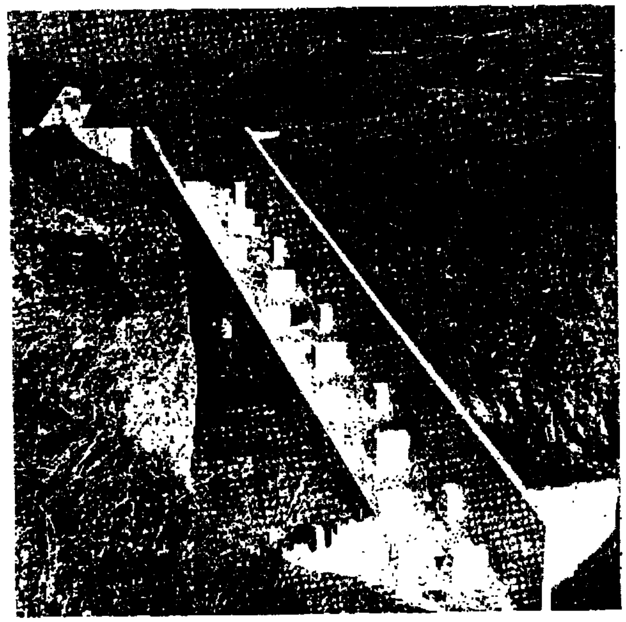


FIGURE 140.—*Basic proportions of a baffled chute.*

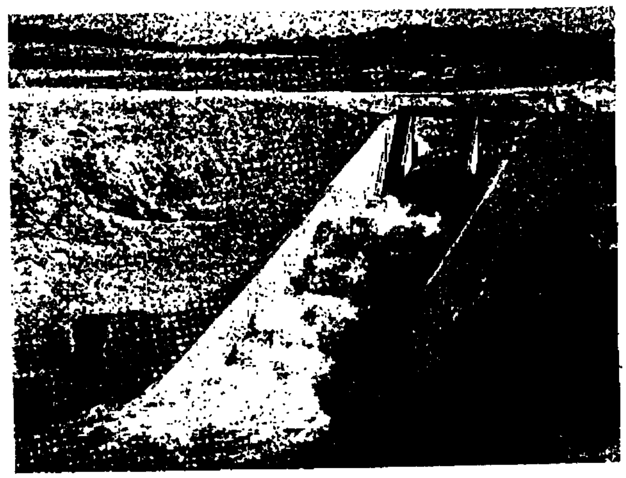
10. The chute training walls should be three times as high as the baffle piers (measured normal to the chute floor) to contain the main flow of water and splash. It is impractical to increase the wall heights to contain all the splash.

11. Riprap consisting of 6- to 12-inch stones should be placed at the downstream ends of the training walls to prevent eddies from working behind the chute. The riprap should not extend appreciably into the flow area. Figures 126 to 139 show effective and ineffective methods of placement on field structures.





(Above) Setting forms for baffled chute at Sta. 3+35 of Wasteway 10.7, and (upper right) compacting backfill at Sta. 2+85 of Wasteway 11.1, Culbertson Canal, Missouri River Basin project.



(Lower right). A discharge of 63 c.f.s. flowing into Helena Valley Regulating Reservoir, Missouri River Basin project, from Helena Canal. Soft earth bank is eroded, otherwise, performance is excellent.

FIGURE 126.—*Construction and performance of baffled chutes.*

Figure 126 shows construction techniques used on two baffled chutes and operation of another at partial capacity. In the latter photograph, a small quantity of riprap on the earth bank would have prevented undermining and sloughing of the soft earth at the downstream end of the right training wall.

The baffled chute shown in Figure 127 is on the Boulder Creek Supply Canal and has operated many times over a range of discharges approaching the design discharge. As a result, a shallow pool has been scoured at the base of the structure. This is desirable, since the pool tends to reduce surface waves and make bank protection downstream from the structure unnecessary. A relatively small quantity of riprap has been placed to achieve the maximum benefit. Also, the wetted area (darker color) adjacent to the training walls starts at about the second row of baffles. This is caused by a small amount of splash which rises above the walls and is carried by air currents. No reports have ever been received that this splash or water loss is of any consequence.

Figure 128 shows a low-drop baffled chute on the Bostwick Courtland Canal. It appears that grass has stabilized the banks sufficiently for the

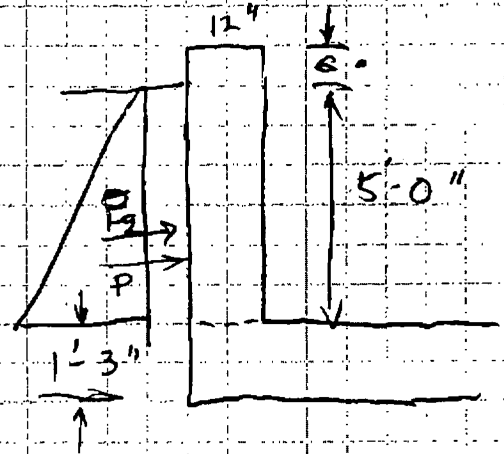
HN

UTILITY ENGINEERING

1-8-03

SMUD

Detention Pond Spillway
Wall Conc. Dsn



assume dry fill material

W = 115 pcf per wce
Soil report
Stiff Clay

$P = W \times h^2/2 = 115 \times 5^2/2 = 1437.5\#$

@ 1.66 from inside Bottom

$M = 1437.5 \times 1.66 = 2395.83$ ft-lbs

ACI factor $2395.83 \times 1.7 = 4072.91$ ft-lbs

Earth Quake loads per CBC 1630.2.1
(Pg. 2-14)

Max EQ Shear (@ ½ wall ht)

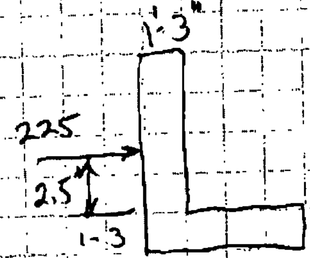
Per CBC
(Eqn 30-5)

$V_{max} = \left(\frac{2.5\, C_a I}{R}\right) W$

$C_a = .36$
$I = 1.00$
$R = 2.90$
$W = 5 \times 1 \times 145 = 725$

$V_{max} = \left(\frac{2.5 \times .36 \times 1.00}{2.90}\right) \times 725 = 225\#$

UTILITY ENGINEERING



$M = (1.7 \times 225) \times 2.5 = 956.25$ ft-lbs (w/ACI)

Max Moment on Wall incl EQ =

$M_u = 4072.91 + 956.25 = 5029.16$ ft-lbs
60.34 in-kips

w/ #5 @ 10" : $A_s = .31 \times \frac{12}{10} = .37$
$f'_c = 4$ ksi $f_y = 60$ ksi

$a = A_s f_y / .85 f'_c b = .37 \times 60 / .85 \times 4 \times 12 = .5441$

$M_u = \phi A_s f_y \left(d - \frac{a}{2}\right)$
$= .9 \times .37 \times 60 \left(9 - .5441/2\right)$
$= 174.38 > 60$ ✓

#5 @ 10" each way OK
Both faces

$A_s = \rho bd = .0020 \times 12 \times 12 = .288 < .37$
ACI 14.3.3

Per ACI code 10" wall thickness requires 2 layers reinforcement

ACI 14.3.4

UTILITY ENGINEERING

ACI-99 12.5.3

development length, #5 bar hook Gr 60

$L = 1200 \times d_b / \sqrt{f'_c}$

$1200 \times .625 / \sqrt{4000} =$

11.85

Use x .7 if 3" cover on hook

11.8 x .7 = 8.3 < 9 ✓ OK

Per T.P. .7 factor not allowed.

∴ Use floor thickness = 1'-3"

UTILITY ENGINEERING

Offsite Drainage

from CH2M Hill HEC 60 cfs for channel #1
82 cfs " " #2
142 cfs from South and east of Plant Site

SMUD Meeting Notes:

"Fairy Shrimp" 1ac @ $60,000 per

Raise west side of Laydown area to divert off site flow.

SMUD: Provide 3' freeboard on Main D Pond

Minimize land disturbance for "fairy shrimp"
Remove drainage channel off site - use existing channel in laydown area for Both Channel flow - divert up Stream.

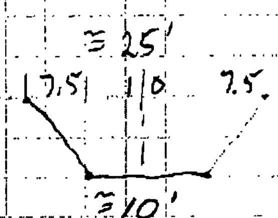
H Noble — UTILITY ENGINEERING — 12-3-02

SMUD Drainage

Laydown Area Revised Drainage Plan

Capacity of Existing Channel in Laydown area.

$n = .040$



$2'\text{-}0'' \sim 2.4'$

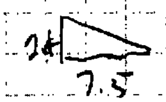
$A = 2.4 \times 10 = 24$

$\underline{18}$

42

$A = 42$ $\quad R = A/WP$

$A/WP = 42/26 = 1.61$



Total $L = 950'$, $h = 8'$

Partial $L = 600$, $h = 4$

$S = h/L = 8/950' = .0084 \quad S^{1/2} = .0917$

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}$$

$$= \frac{1.49}{.040} \times 42 \times 1.37 \times .0917$$

$Q = 196$ cfs w/ $S = .0084$ total Slope

Partial Slope: $S = \frac{h}{L} = \frac{4}{600} = .0067$

$S^{1/2} = .0816$

$Q = 175$ cfs

* Summary: the existing drainage channel appears to handle the entire offsite flow. Culverts under Clay Road take this to the Creek. No West Side flow will happen.

UTILITY ENGINEERING

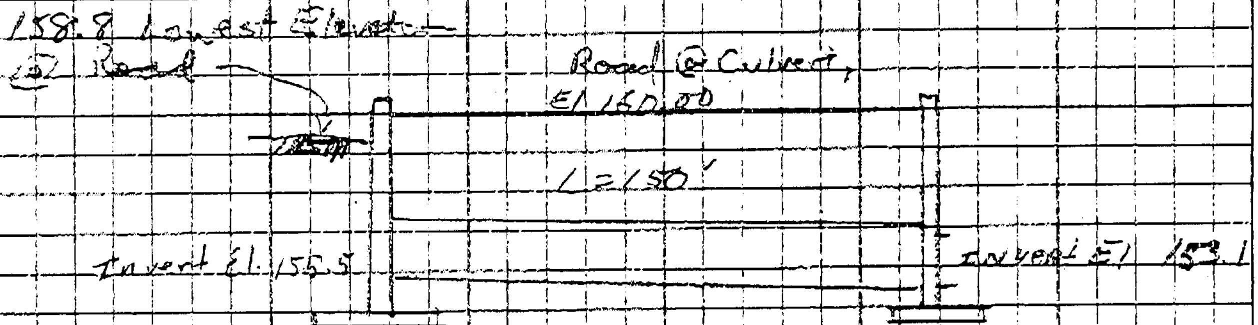
BN

1-23-02

Revised

Laydown Area & BF Site Drainage

Culvert @ Clay Road



42x29 Arch Pipe - Concrete

A = 6.4   R = 0.679

Determine Maximum H -

Lowest Elevation on Road = 158.8

Assume outlet Control Condition, Pipe flowing full

$H = 158.8 - \left(153.1 + \left(\frac{2.9}{2}\right)\right) = 3.28'$

Calculate Capacity of pipe using 3.28' head vs 2.4 assumed earlier

3.28 actual Head available at Site

UTILITY ENGINEERING

$$H = \left(1 + Ke + \frac{29 n^2 L}{R^{1.33}}\right)\frac{V^2}{2g}$$

$Ke = 0.5 \qquad n = .024$

$A = 6.4 \qquad R = 0.679 \qquad L = 150'$

$$H = \left(1 + .5 + \left(\frac{29 \times .024^2 \times 150}{.679^{1.33}}\right)\right) V^2/2g$$

$$H = 5.69 \frac{V^2}{2g}$$

$$3.28 = \frac{5.69}{64.4} \times V^2$$

$$3.28 = .0884\, V^2$$

$37.1038 = V^2, \quad V = 6.0913$ fps

$Q = AV = 6.4 \times 6.0913 = 38.98$ cfs

$Q = 38.98$ cfs $\times$ 4 pipes

Total Capacity $= 155.94$ cfs > 142 cfs req'd

$\therefore$ 4 pipe Culvert will pass entire 100 year event of 142 cfs per [illegible] Calcs without overtopping Roadway anywhere

UTILITY ENGINEERING

RM 1-22-03

SIMUD - Flow and Drainage of
West Existing Culvert @ Clay Road

Area 980 x 500' = 490,000 SF
144000

Existing Culvert : 17" x 22" arch Pipe CMP

area = 2.2 sF R = 0.40

Q_{100} = 3.80 cfs , Q = AV

V = Q/A 3.80/2.2 = 1.727 fps

$$H = \left(1 + Ke\left(\frac{29 n^2 L}{R^{1.33}}\right)\right)\frac{V^2}{2g}$$

$$= \left(1 + .9\left(\frac{29 \times .024^2 \times 40}{.4^{1.33}}\right)\right) \times \frac{1.73^2}{64.4}$$

H = (1.9 + 2.26) x .0465

H = 0.19' ✓

Existing Culvert will handle runoff from this portion of Site

Flow of 3.8cfs added to Swale ditch flow 15cfs, into Detention Pond increases depth flow in swale from ≅ .95' to 1.1' ± See Sht 3 Calc Pkge

UTILITY ENGINEERING

Detention Pond - design to contain 100yr event runoff + discharge 100yr runoff (46 cfs) + 22 cfs from pipe outlet. Therefore, additional 3.8 cfs is not an issue

UTILITY ENGINEERING

KR 1-22-03

SMUD

Rancho Seco - Verify Plant road drainage culvert

Capacity : (oversized for sediment deposits)

42"x29" Conc Arch Pipe

Max length = 40'

$A = 6.4 \quad R = .679$

Assume $H = 1.5'$

1. $Q = CA\sqrt{2gh}$ (inlet unsubmerged)

$= .62 \times 6.4 (64.4 \times 1.5)^{\frac{1}{2}}$

$= 38.99$ cfs

2. $H = \left(1 + k_e + \frac{29 n^2 L}{R^{1.33}}\right) \frac{V^2}{2g}$ inlet unsubmerged, outlet submerged

$1.5 = \left(1 + .7 + \frac{29 \times (.024)^2 \times 40}{.579^{1.33}}\right) \frac{V^2}{2g}$

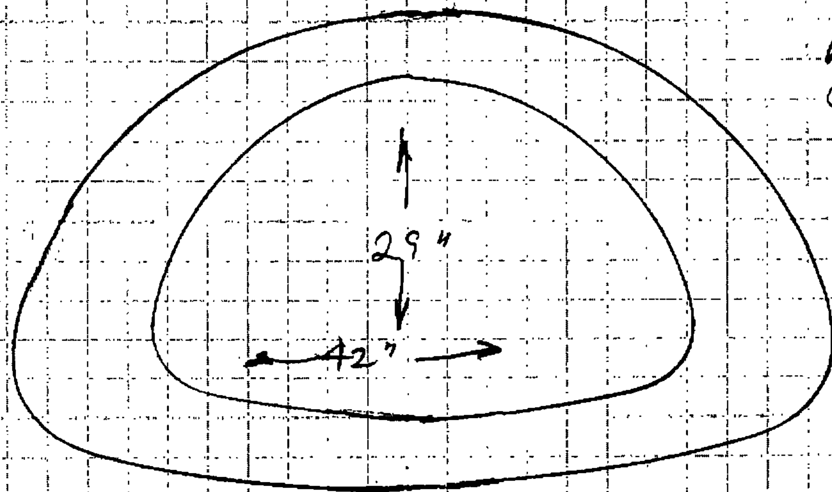
$1.5 = 2.818 \frac{V^2}{2g} \quad V = \sqrt{\frac{1.5}{.0438}} = \sqrt{34.3}$

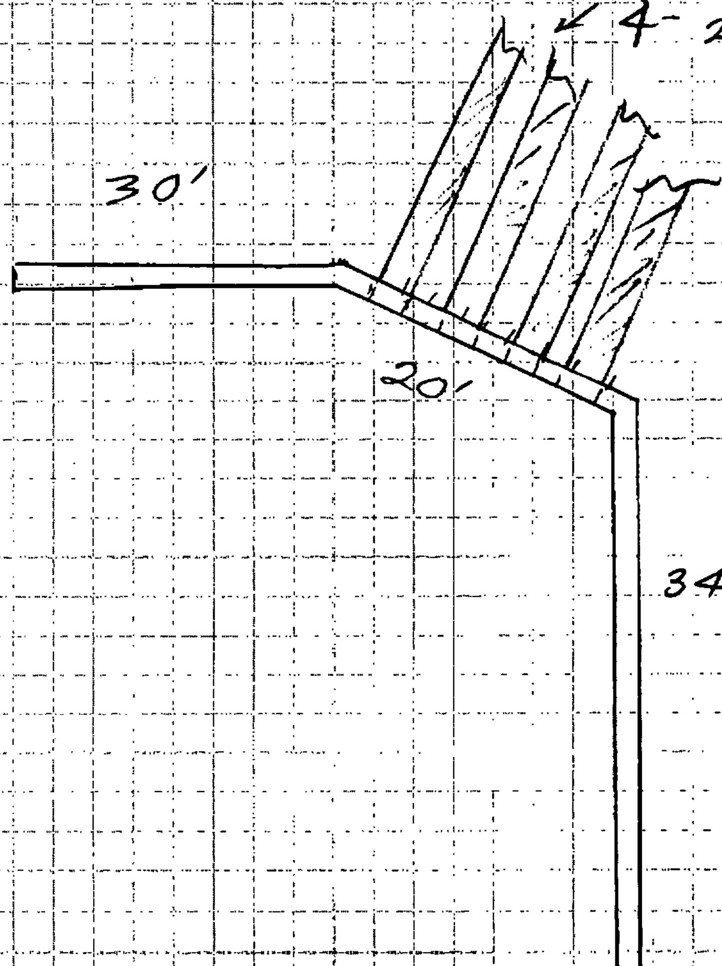
$V = 5.85$ ✓ $\quad Q = AV = 6.4 \times 5.85 = 37.47$

42x29 Arch pipe Culvert has sufficient Capacity in all locations. Max Q = 9cfs @ Phase 3 Area

UTILITY ENGINEERING

Reinforced, Concrete Arch Pipe





4- 29x42 RCP, arched
150' Long

UTILITY ENGINEERING

DKV 1-13-03
SMUD - RETAINING WALL
(CULVERT HEADWALL)

GIVEN:

RETAINED HEIGHT - 9.0 FT
ALL. SOIL BEARING - 2000 PSF
SOIL FRICTION ANGLE - 30°
FOOTING/SOIL FRICTION - 0.40
DESIGN SOIL DENSITY - 135 PCF

$f'_c = 4{,}000$ PSI
$f_y = 60{,}000$ PSI

CODES:

1998 CBC
ACI 318-02

ASSUMPTIONS:

a) BACKFILL SLOPE IS LEVEL (NO SLOPE)
b) STEM & FOOTING IS 1'-3" THICK.
c) CALCULATIONS ARE FOR 1'-0" WIDE STRIP OF WALL
d) GROUND WATER BELOW FOOTING - STRUCTURE WELL DRAINED
e) KEY IS 2'-0" DEEP X 1'-3" WIDE
f) NO SURCHARGE OVER TOE

CALCULATIONS

EARTH PRESSURE

$K_A = \tan^2(45 - 30/2) = 0.333$ $\qquad K_A \gamma = 0.333(135) = 45$ PCF

$K_P = 1/K_A = 3.00$ $\qquad K_P \gamma = 3(135) = 405$ PCF

$R_A = 1/2(45)(10.25)^2 = 2{,}363.91$ lb/ft

$R_P = 1/2(405)(3.25)^2 = 2{,}138.91$ lb/ft

SURCHARGE LINE LOAD

ASSUMPTION: 8,000 lb WHEEL LOAD LOCATED 1'-0" OFF OF WALL

FOR $m < 0.4$ $\quad \sigma_h = \dfrac{V}{H^2} \dfrac{(0.28)n^2}{(0.16+n^2)^3}$

Z (FT)	n = Z/H	σ_h (lb/ft²)
0	0.00	0.00
1	0.11	65.65
2	0.22	147.88
3	0.33	154.89
4	0.44	121.10
5	0.55	84.56
6	0.66	57.01
7	0.77	38.42

Z (FT)	n = Z/H	σ_h (lb/ft²)
8	0.88	26.25
9	1.00	17.72

$R = 114.8 \cong 115$ lb/ft²

$> (2)(45) = 90$ lb/ft² (ok)

UTILITY ENGINEERING

DKV 1-13-02
SMUD - RETAINING WALL (CULVERT HEADWALL)

SEISMIC LOAD

$$V_{MAX} = \left(\frac{2.5\,C_a I}{R}\right) \quad \text{WHERE } C_a = 0.36,\ I = 1.00;\ R = 2.90$$

$$V_{max} = 0.310(W)$$

$$W_{STEM} = (9)(1.25)(145) = 1631.3$$

$$V_{MAX} = 506.3 \text{ lbs/ft}$$

RESISTING FORCES

ITEM	AREA (ft^3)	γ (lb/ft^3)	W_L (lbs)	r_L (ft)	MOMENT (ft
STEM	(1.25)(9.5)(1.0) = 11.86	145.0	1721.88	3.38	5811.3
BASE	(1.25)(7.75)(1.0) = 9.69	145.0	1404.69	3.88	5443.2
SOIL	(3.75)(9.0)(1.0) = 33.75	135.0	4556.25	5.88	26768.0
KEY	(2.0)(1.25)(1.0) = 2.50	145.0	362.50	3.38	1223.4
			8,045.32 (lbs)	RM =	39,245.90 (
SURCHARGE	(3.75)(1.0)(2.56) = 9.60	135.0	1296.0	5.88	7,614.0

OVERTURNING FORCES

ITEM	FORCE (lbs)	r_L (ft)	MOMENT (ft·lbs)
HEEL ACTIVE PRESSURE	2,363.91	3.42	8,084.6
LIVE SURCHARGE LOAD	1,035	5.75	5,951.3
SEISMIC LOAD	506	5.75	2,909.5
	3904.9 (lbs)	OTM =	16,945.4 (ft·lbs)

RESISTING/OVERTURNING RATIO = 2.77 > 1.50 (OK)
(INCLUDES SURCHARGE)

RESISTING/OVERTURNING RATIO = 3.57 > 1.50 (OK)
(DOES NOT INCLUDE SURCHARGE)

SLIDING RESISTANCE

LATERAL SLIDING FORCE (W/SURCHARGE) = 3904.9 (lbs)
LATERAL SLIDING FORCE (W/O SURCHARGE) = 2869.9 (lbs)
PASSIVE FORCE = 2,138.9 (lbs)
FRICTION FORCE (W/ SURCHARGE) = 3736.5 (lbs)
FRICTION FORCE (W/O SURCHARGE) = 3218.1 (lbs)

SLIDING RESISTANCE = 1.50 ≥ 1.50 (OK) (W/SURCHARGE)
SLIDING RESISTANCE = 1.87 > 1.50 (OK)

FOUNDATION PRESSURE

TOTAL BEARING LOAD = 9,342 (lbs)

ASSUME TOE LENGTH = 2.75 (ft) & HEEL LENGTH = 3.75 (ft)

$$r = \frac{46,859.9 - 16,945.4}{9342} = 3.20$$

$$e = 7.75/2 - 3.20 = 0.67\ (ft) < 1.29\ (ft) \quad (OK)$$

$$P_{max} = \left(\frac{9342}{7.75}\right)\left(1 + \frac{6(0.67)}{7.75}\right) = 1831\ PSF < 2{,}000\ PSF \quad (OK)$$

$$P_{min} = \left(\frac{9342}{7.75}\right)\left(1 - \frac{6(0.67)}{7.75}\right) = 580\ PSF$$

CONCRETE DESIGN

FACTORED VERTICAL LOAD

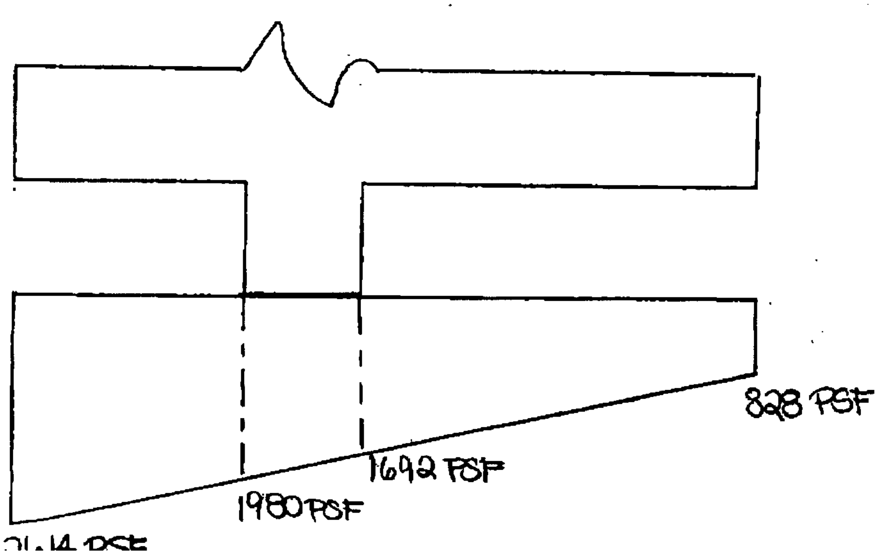
$$\Sigma w_u = 1.4(1721.9 + 1404.7 + 4556.3 + 362.5) + 1.6(1296.0)$$

$$= 2410.7 + 1966.6 + 6378.8 + 507.5 + 2073.6$$

$$= 13,337.2\ (lbs)$$

$$q_u = \left(\frac{13,337.2}{7.75}\right)\left(1 \pm \frac{6(0.67)}{7.75}\right)$$

$q_{TOE} = 2614$ PSF $\qquad q_{u_{HEEL}} = 828$ PSF



TOE DESIGN

$M_u = (1980)(2.75)(1.375) + (634)(2.75)\tfrac{1}{2}(1.833) - (2.75)(1.25)(145)(1.375)$

$= 8{,}125 \text{ ft}\cdot\text{lbs}$

$d = 15'' - 3'' - \tfrac{1}{2}'' = 11.5 \text{ in}$

$$\rho = \frac{0.85(4)\left(1 - \sqrt{1 - \frac{(8125)(12)}{0.383(12)(11.5)^2(4000)}}\right)}{60} = 0.00115 < 0.0033$$

$A_{s_{min}} = 0.0033(12)(11.5) = 0.46 \text{ in}^2$ #5 @ 8.0 in c/c $A_s = 0.47 \text{ in}^2$

$V_u = (1980)(2.75) + (634)(2.75)\tfrac{1}{2} - (2.75)(1.25)(145)(1.4) = 5619 \text{ lbs} < \phi V_c$

$\phi V_c = (2)(0.85)(12)(11.5)\sqrt{4000} = 14{,}837 \text{ lbs}$ (OK)

HEEL DESIGN

$M_u = (828)(3.75)(1.875) - (864)(3.75)\tfrac{1}{2}(1.25) + (3.75)(1.25)(145)(1.875)(1$

$+ (9.0)(3.75)(135)(1.875)(1.4) + (2.56)(3.75)(1.875)(135)(1.6)$

$= 9{,}785 \text{ (ft}\cdot\text{lbs)}$

$$\rho = \frac{0.85(4)\left(1 - \sqrt{1 - \frac{9785(12)}{0.383(12)(11.5)^2(4000)}}\right)}{60} = 0.0014 < 0.0033$$

$A_{s_{MIN}} = 0.46 \text{ in}^2$ #5 @ 8.0 in c/c

$V_u = (828)(3.75) - (864)(3.75)\tfrac{1}{2} + (3.75)(1.25)(145)(1.4) + (9.0)(3.75)(135)(1.4$

$+ (2.56)(3.75)(135)(1.6) = 4679 \text{ lbs} < \phi V_c$ (OK)

STEM DESIGN

$M_u = (1035)(4.5)(1.6) + (506)(4.5)(1.6) + (405)(9)(\tfrac{1}{2})(3)(1.6)$

$= 19,843.2 \text{ ft}\cdot\text{lbs}$

$d = 15 - 2 - 0.625 - 0.625/2 = 12.0625 \cong 12.0 \text{ in}$

$$\rho = \frac{0.85(4)\left(1-\sqrt{1-\dfrac{19{,}843.2\,(12)}{0.383\,(12)(12)^2(4000)}}\right)}{60} = 0.0026 < 0.0033$$

$As_{min} = 0.47 \text{ in}^2$ #5 @ 8.0 in c/c

$V_u = (1035)(1.6) + (506)(1.6) + (405)(9)(0.5)(1.6) = 5381.6 \text{ (lbs)} < \phi V_c$ (OK)

KEY DESIGN

$M_u = (506.25)(2.0)(1.0)(1.6) + (810)(2)(\tfrac{1}{2})(0.667)(1.6)$

$= 2,484 \text{ ft}\cdot\text{lbs}$

USE MIN STEEL

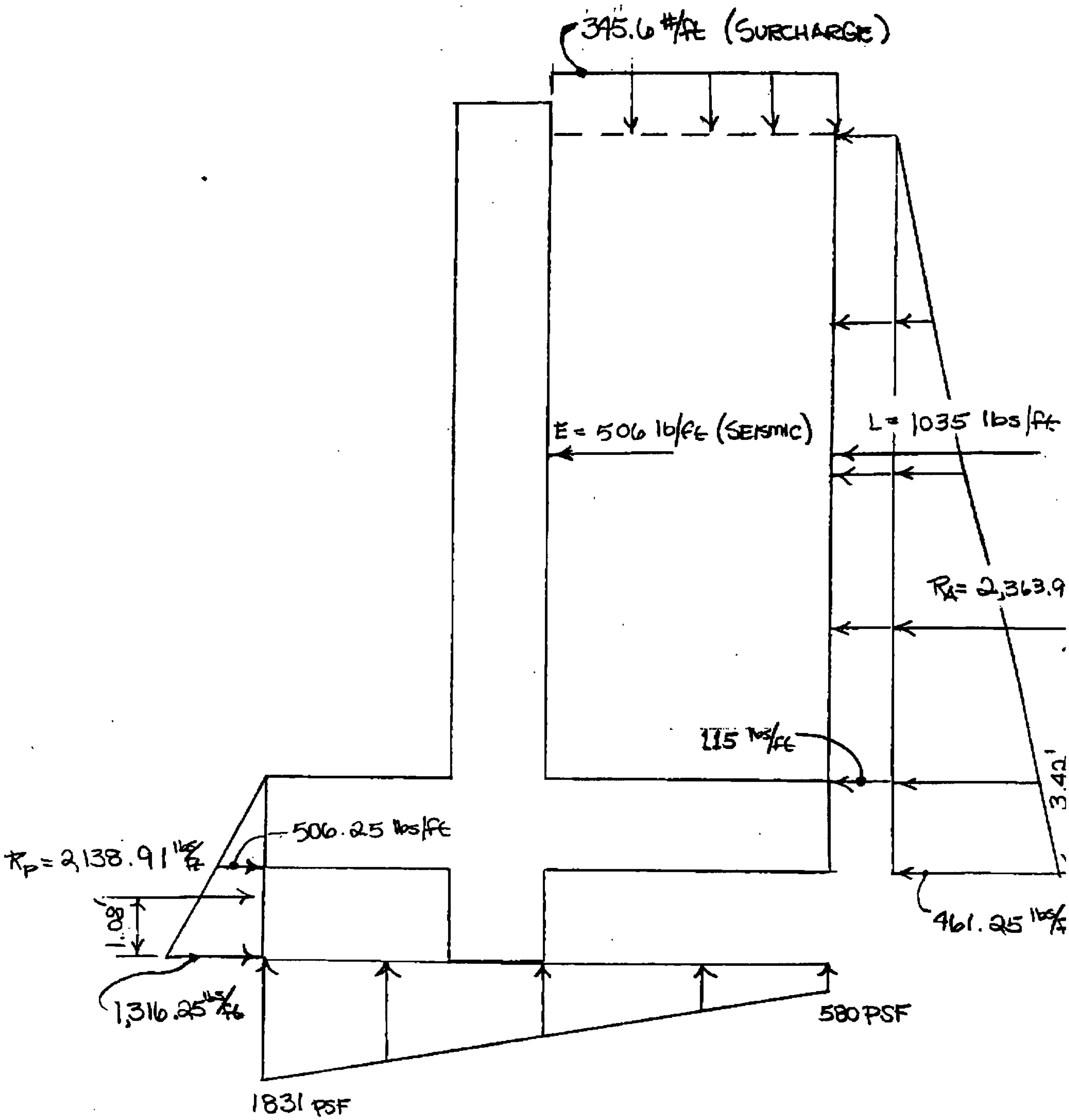
$As_{min} = 0.47 \text{ in}^2$ #5 @ 8.0 in c/c

$V_u < \phi V_c$

UTILITY ENGINEERING

DKY 1-13-0

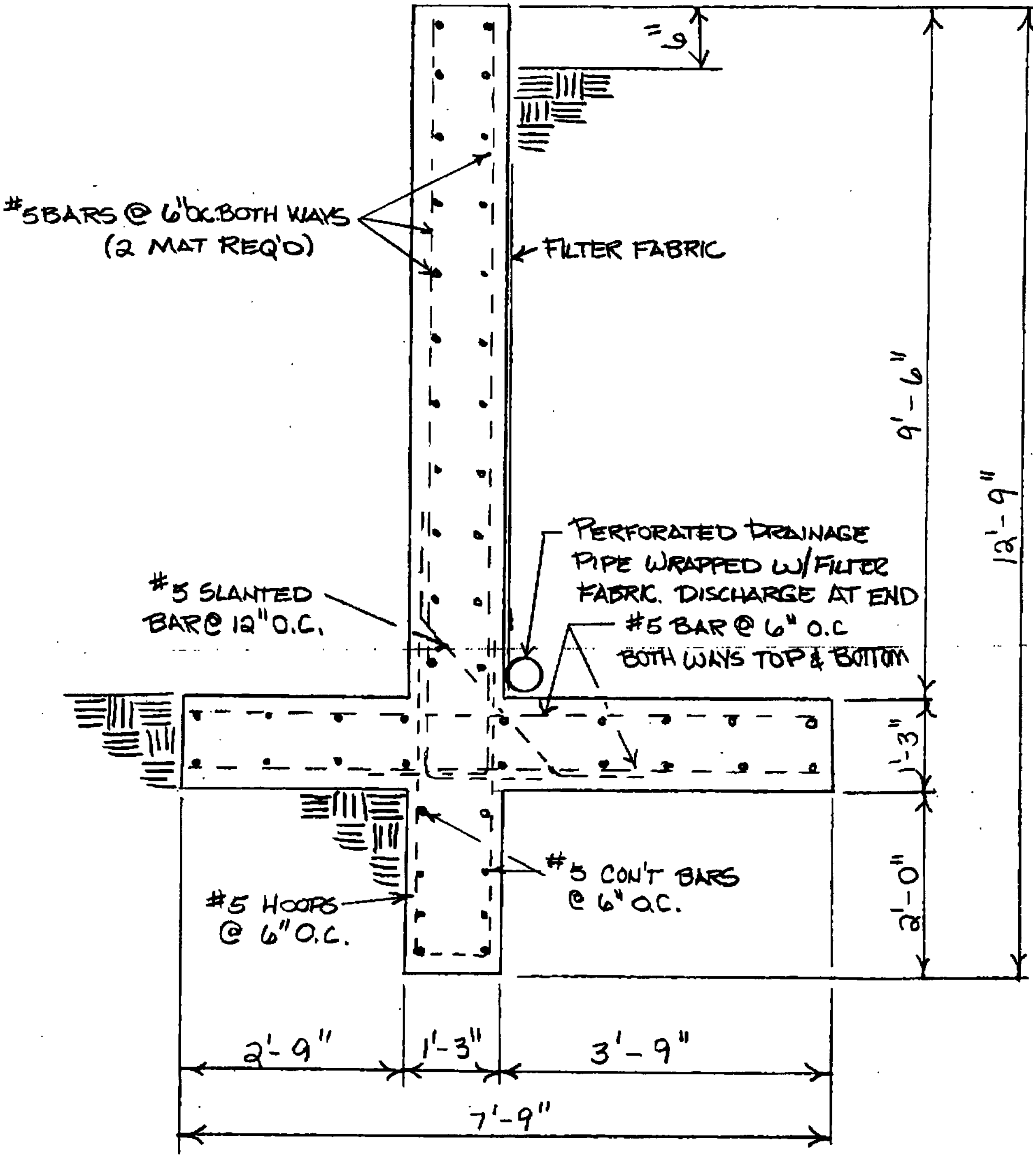
SMUD - RETAINING WALL
(CULVERT HEADWALL)



UTILITY ENGINEERING

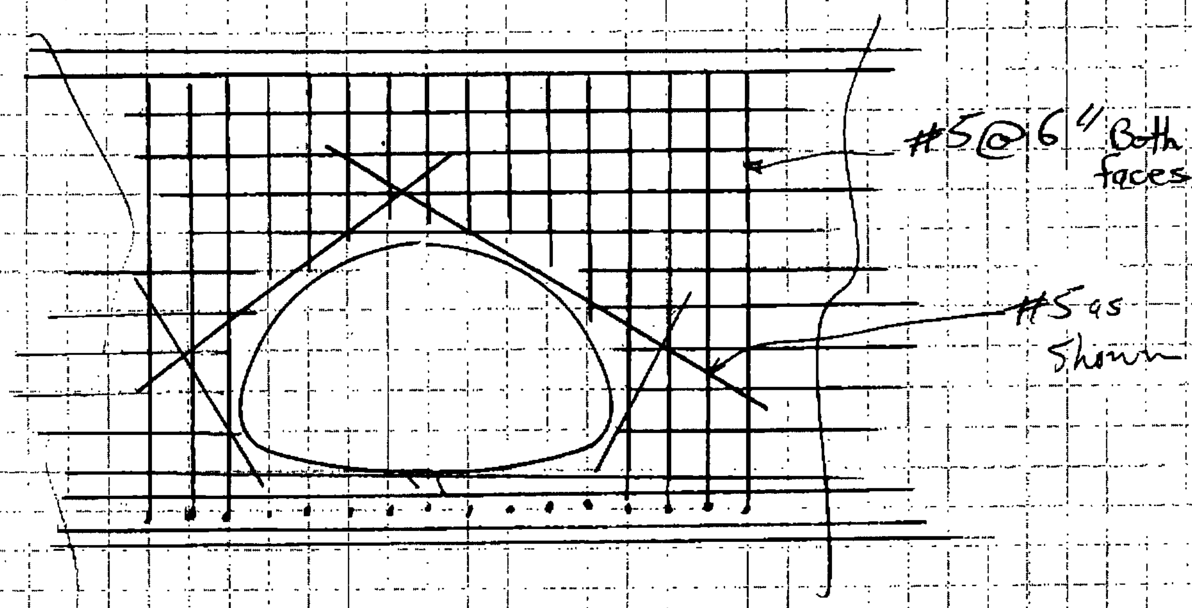
DKV 1-13-03

SMUD-RETAINING WALL (CULVERT HEADWALL)



UTILITY ENGINEERING

additional Reinforcemet @ pipes



SMUD
Calculation of Storm Runoff Flowrates & Volumes
for a 100 yr., 24 hr Storm

V =cPA
Q =ciA

Entire Plant Area, Phase 2, substation, draining into detention pond

<u>100 yr., 24 hr.</u>

cumulative rainfall depth =	4	(in)	
% of cumulative rainfall within given time period =	0.153	%	Based on the Soil Conservation Service's Type I rainfall distribution. See the following spreadsheets for determination of this value.
peak time period =	0.25	(hr)	
maximum rainfall intensity =	2.45	(in/hr)	

			runoff coefficient - c	
Total area of land =	1242000	(ft^2)	0.41	(for undeveloped pasture/rangeland, flat 0-2%, 100 yr. storm)
	28.51	(acres)	0.66	(for developed site, 100 yr. storm)
Area of paved or	487000	(ft^2)		
concreted surfaces =	11.18	(acres)	0.95	(for 100 yr. storm, asphalt surface)
Area of gravel, grass,	755000	(ft^2)		
(developed) surfaces =	17.33	(acres)	0.47	(for 100 yr. storm, flat 0-2% poor condition grass, < 50% grass)

Developed Site			Undeveloped Site		
c =	0.66		**c =**	0.41	
P =	4	in	**P =**	4	in
A =	28.51	acres	**A =**	28.51	acres
i =	2.45	in/hr	**i =**	2.45	in/hr
(24 hr. storm)			**(24 hr. storm)**		
Volume of Runoff =	**6.256**	**acre*ft**	**Volume of Runoff =**	**3.897**	**acre*ft**
Peak Flowrate =	**45.94**	**cfs**	**Peak Flowrate =**	**28.62**	**cfs**

SMUD
Calculation of Storm Runoff Flowrates & Volumes
for a 10 yr., 24 hr Storm

SW Corner Power Block

V =cPA
Q =ciA

10 yr., 24 hr.

			runoff coefficient - c	
cumulative rainfall depth =	3	(in)		
% of cumulative rainfall within given time period =	0.153	%		Based on the Soil Conservation Service's Type I. rainfall distribution (pg. 461) See the following spreadsheets for determination of this value.
peak time period =	0.25	(hr)		
maximum rainfall intensity =	1.84	(in/hr)		
Total area of land =	60000	(ft^2)	0.41	(for undeveloped pasture/rangeland, flat 0-2%, 10 yr. storm)
	1.38	(acres)	0.56	(for developed site, 100 yr. storm)
Area of paved or	10700	(ft^2)		
concreted surfaces =	0.25	(acres)	0.95	(for 10 yr. storm, asphalt surface)
Area of gravel, grass,	49300	(ft^2)		
(developed) surfaces =	1.13	(acres)	0.47	(for 10 yr. storm, flat 0-2% poor condition grass, < 50% grass)

Developed Site			Undeveloped Site		
c =	0.56		**c =**	0.41	
P =	3	in	**P =**	3	in
A =	1.38	acres	**A =**	1.38	acres
i =	1.84	in/hr	**i =**	1.84	in/hr
(24 hr. storm)			**(24 hr. storm)**		
Volume of Runoff =	0.191	acre*ft	**Volume of Runoff =**	0.141	acre*ft
Peak Flowrate =	1.41	cfs	**Peak Flowrate =**	1.04	cfs

SMUD

Calculation of Storm Runoff Flowrates & Volumes

for a 10 yr., 24 hr Storm

N W Corner Power Block

V =cPA
Q =ciA

10 yr., 24 hr.

cumulative rainfall depth =	3	(in)	
% of cumulative rainfall within given time period =	0.153	%	Based on the Soil Conservation Service's Type I rainfall distribution (pg. 461) See the following spreadsheets for determination of this value.
peak time period =	0.25	(hr)	
maximum rainfall intensity =	1.84	(in/hr)	

			runoff coefficient - c	
Total area of land =	93750	(ft^2)	0.41	(for undeveloped pasture/rangeland, flat 0-2%, 10 yr. storm)
	2.15	(acres)	0.53	(for developed site, 100 yr. storm)
Area of paved or	12500	(ft^2)		
concreted surfaces =	0.29	(acres)	0.95	(for 10 yr. storm, asphalt surface)
Area of gravel, grass,	81250	(ft^2)		
(developed) surfaces =	1.87	(acres)	0.47	(for 10 yr. storm, flat 0-2% poor condition grass, < 50% grass)

Developed Site			**Undeveloped Site**		
c =	0.53		**c =**	0.41	
P =	3	in	**P =**	3	in
A =	2.15	acres	**A =**	2.15	acres
i =	1.84	in/hr	**i =**	1.84	in/hr
(24 hr. storm)			**(24 hr. storm)**		
Volume of Runoff =	**0.287**	**acre*ft**	**Volume of Runoff =**	**0.221**	**acre*ft**
Peak Flowrate =	**2.11**	**cfs**	**Peak Flowrate =**	**1.62**	cfs

SMUD
Calculation of Storm Runoff Flowrates & Volumes
for a 10 yr., 24 hr Storm

V =cPA
Q =ciA

Entire Site draining into detention pond

10 yr., 24 hr.			
cumulative rainfall depth =	3	(in)	
% of cumulative rainfall within given time period =	0.153	%	Based on the Soil Conservation Service's Type I rainfall distribution. See the following spreadsheets for determination of this value.
peak time period =	0.25	(hr)	
maximum rainfall intensity =	1.84	(in/hr)	

			runoff coefficient - c	
Total area of land =	1242000	(ft^2)	0.41	(for undeveloped pasture/rangeland, flat 0-2%, ~~100~~ 10 yr. storm)
	28.51	(acres)	0.66	(for developed site, 10 yr. storm)
Area of paved or	487000	(ft^2)		
concreted surfaces =	11.18	(acres)	0.95	(for 10 yr. storm, asphalt surface)
Area of gravel, grass,	755000	(ft^2)		
(developed) surfaces =	17.33	(acres)	0.47	(for 10 yr. storm, flat 0-2% poor condition grass, < 50% grass)

Developed Site			Undeveloped Site		
c =	0.66		c =	0.41	
P =	3	in	P =	3	in
A =	28.51	acres	A =	28.51	acres
i =	1.84	in/hr	i =	1.84	in/hr
(24 hr. storm)			(24 hr. storm)		
Volume of Runoff =	4.692	acre*ft	Volume of Runoff =	2.923	acre*ft
Peak Flowrate =	34.46	cfs	Peak Flowrate =	21.46	cfs

SMUD
Calculation of Storm Runoff Flowrates & Volumes
for a 10 yr., 24 hr Storm

Phase 2 area

V =cPA
Q =ciA

10 yr., 24 hr.

cumulative rainfall depth =	3	(in)		
% of cumulative rainfall				Based on the Soil Conservation Service's Type I rainfall distribution (pg. 461)
within given time period =	0.153	%		See the following spreadsheets for determinati. of this value.
peak time period =	0.25	(hr)		
maximum rainfall intensity =	1.84	(in/hr)		
			runoff coefficient - c	
Total area of land =	429000	(ft^2)	0.41	(for undeveloped pasture/rangeland, flat 0-2%, 10 yr. storm)
	9.85	(acres)	0.51	(for developed site, 100 yr. storm)
Area of paved or	37600	(ft^2)		
concreted surfaces =	0.86	(acres)	0.95	(for 10 yr. storm, asphalt surface)
Area of gravel, grass,	391400	(ft^2)		
(developed) surfaces =	8.99	(acres)	0.47	(for 10 yr. storm, flat 0-2% poor condition grass, < 50% grass)

Developed Site			Undeveloped Site		
c =	0.51		**c =**	0.41	
P =	3	in	**P =**	3	in
A =	9.85	acres	**A =**	9.85	acres
i =	1.84	in/hr	**i =**	1.84	in/hr
(24 hr. storm)			**(24 hr. storm)**		
Volume of Runoff =	**1.261**	**acre*ft**	**Volume of Runoff =**	**1.009**	**acre*ft**
Peak Flowrate =	**9.26**	**cfs**	**Peak Flowrate =**	**7.41**	**cfs**

SMUD
Calculation of Storm Runoff Flowrates & Volumes
for a 10 yr., 24 hr Storm

V =cPA
Q =ciA

Substation & phase 2 areas

<u>10 yr., 24 hr.</u>				
cumulative rainfall depth =	3	(in)		
% of cumulative rainfall				Based on the Soil Conservation Service's Type I rainfall distribution
within given time period =	0.153	%		See the following spreadsheets for determination of this value.
peak time period =	0.25	(hr)		
maximum rainfall intensity =	1.84	(in/hr)		
			runoff coefficient - c	
Total area of land =	753500	(ft^2)	0.41	(for undeveloped pasture/rangeland, flat 0-2%, 10 yr. storm)
	17.30	(acres)	0.47	(for developed site, 10 yr. storm)
Area of paved or	5500	(ft^2)		
concreted surfaces =	0.13	(acres)	0.95	(for 10 yr. storm, asphalt surface)
Area of gravel, grass,	748000	(ft^2)		
(developed) surfaces =	17.17	(acres)	0.47	(for 10 yr. storm, flat 0-2% poor condition grass, < 50% grass)

Developed Site			**Undeveloped Site**		
c =	0.47		**c =**	0.41	
P =	3	in	**P =**	3	in
A =	17.30	acres	**A =**	17.30	acres
i =	1.84	in/hr	**i =**	1.84	in/hr
(24 hr. storm)			**(24 hr. storm)**		
Volume of Runoff =	**2.048**	**acre*ft**	**Volume of Runoff =**	**1.773**	**acre*ft**
Peak Flowrate =	**15.04**	**cfs**	**Peak Flowrate =**	**13.02**	cfs

SMUD
Calculation of Storm Runoff Flowrates & Volumes
for a 100 yr., 24 hr Storm

V =cPA
Q =ciA

West side laydown area and hillside

<u>100 yr., 24 hr.</u>

cumulative rainfall depth =	4	(in)	
% of cumulative rainfall within given time period =	0.153	%	Based on the Soil Conservation Service's Type I rainfall distribution. See the following spreadsheets for determination of this value.
peak time period =	0.25	(hr)	
maximum rainfall intensity =	2.45	(in/hr)	

			runoff coefficient - c	
Total area of land =	490000	(ft^2)	0.41	(for undeveloped pasture/rangeland, flat 0-2%, 100 yr. storm)
	11.25	(acres)	0.14	(for developed site, 100 yr. storm)
Area of paved or	0	(ft^2)		
concreted surfaces =	0.00	(acres)	0.95	(for 100 yr. storm, asphalt surface)
Area of gravel, grass,	144000	(ft^2)		
(developed) surfaces =	3.31	(acres)	0.47	(for 100 yr. storm, flat 0-2% poor condition grass, < 50% grass)

Developed Site			Undeveloped Site		
c =	0.14		c =	0.41	
P =	4	in	P =	4	in
A =	11.25	acres	A =	11.25	acres
i =	2.45	in/hr	i =	2.45	in/hr
(24 hr. storm)			(24 hr. storm)		
Volume of Runoff =	[redacted]	acre*ft	Volume of Runoff =	[redacted]	acre*ft
Peak Flowrate =	[redacted]	cfs	Peak Flowrate =	[redacted]	cfs